The World Area Forecast System (WAFS) Internet File Service (WIFS) Users Guide

By

WAFC Washington

Version 5

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Document Change History

Date	Version	Description[1]
24-Feb-10	1.0	Initial draft release.
26-Mar-10	1.1	Incorporated user feedback including: new document change history section, correction to Table 2 GRIB/GRIB2 description, additional descriptions where necessary, section heading changes, and more.
30-Mar-10	1.2	Based on feedback from reviewers, made some changes to the User Authentication fields.
5-Apr-10	1.2	Based on feedback from reviewers, added "WAFC Washington" wording to title, footer, and the Introduction.
26-Apr-10	1.2	Based on feedback from reviewers: (1) section 2 was renamed "Service Overview and Responsibilities of U.S. Government Agencies", (2) section 3 was renamed "Data Retrieval Process", (3) backup information was added to section 4, (4) section 7 "Responsibilities of U.S. Government Agencies" was renamed "WIFS Customer Support" and is now section 8, and (5) more information was added to the WIFS Customer Support section including information on a trouble ticket system.
20-May-10	1.3	Based on technical interchange with customers, the GRIB data is now being served in a concatenated file format. The description of the file formats in Section 6 reflects this change. Based on feedback from reviewers: (1) Appendix A was added to describe the GNU wget utility, (2) Section 3 was modified to include a reference for Appendix, (3) minor changes were made in Section 4 to clarify back-up roles and responsibilities, and (4) Section 4.2 title was modified.
15-Jul-10	2.0	Folded in the contents of the WIFS Interface Control Document; added Appendix B, Reference Documents; expanded the GNU wget description in Appendix A; updated Section 3 Data Retrieval Process; added Appendix C WIFS Registration; changed link to software providers in Section 3; reorganized Section 4 based on reviewer comments; added new Section 4.3 Suspension of Access; added note to Section 5 that mentions potential harmonization of directory structures.
26-Aug-10	2.1	Changed WIFS help desk phone number.
1-Nov-10	3.0	Completed Draft Interim Version: Added introductory information Reorder sections for logical flow Added Chapter 2, WIFS Products and Data
4-Jan-11	3.1	Added verbiage on authorization criteria. Updated document after review of v3.0.
14-Jan-11	4.0	Document baselined after final reviews.
28-Mar-11	4.1	Modified Section 5 Data Retrieval Process to make it clearer and easier to interpret; this includes removing the site-specific URLs. Added reference to SADIS User Guide Annexes 1 and 4.

Date	Version	Description[1]
4-Dec-17	5.0	Removed any mention of GRIB1 data; changed all mention of "trial" forecast data to "harmonized" data, added expected data availability tables to Section 3; removed trial forecast designation for WIFS aviation grids; modified the directory structure in Section 6; modified Appendix A to include more information about how a user can use WIFS; moved GNU wget information to Appendix B. Added GRIB2 details to Appendix C. FL080 (750 hPa), FL210 (450 hPa) and FL480 (125hPa) were included in the Appendix C table for wind, temperature, RH, and height. Added sections on SIGWX and PNG corrections.

[1] Minor corrections and cosmetic changes are not recorded.

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1. Introduction

ICAO established the World Area Forecast System (WAFS) system in 1982 to supply meteorological authorities and other users with global forecasts of en-route meteorological conditions in digital form. The U.S. and the United Kingdom (UK) share in the global distribution of the WAFS forecasts required in ICAO Annex 3 and the operational meteorological (OPMET) information specified in the Facilities and Services Implementation Document (FASID) Table MET2A.

The U.S. distribution of WAFS forecasts and OPMET information is provided through the WAFS Internet File Service (WIFS). The UK distribution is provided through systems managed by the Secure Aviation Data Information Service (SADIS) program; formerly known as the Satellite Distribution System. WIFS replaced the International Satellite Communication System (ISCS) and is compliant with ICAO Document 9855, Guidelines on the Use of the Public Internet for Aeronautical Applications. The U.S. WAFS forecasts are provided by the Washington World Area Forecast Center (WAFC). The Washington WAFC is operated by the United States National Weather Service (NWS).

Through access to WIFS, States may wish to meet their obligation under Article 28 of the Convention on International Civil Aviation regarding the provision of meteorological services to facilitate international air navigation. Regarding the use of WAFS products, for example, ICAO Annex 3 specifically notes in Appendix 2, Section 2.1.1: "Aerodrome meteorological offices shall use WAFS forecasts issued by the WAFCs in the preparation of flight documentation, whenever these forecasts cover the intended flight path in respect of time, altitude and geographical extent, unless otherwise agreed between the meteorological authority and the operator concerned."

WIFS provides access to authorized users as described in Section 4.

1.1. Reference Documents

1.1.1. International Standards

- International Standard ISO 8802-2: 1998 Part 2: Logical Link Control
- WMO Publication 306 Manual on Codes
- WMO Publication 386 Manual on the Global Telecommunications System
- WMO Publication FM92 GRIB Edition 2
- WMO Publication FM94 BUFR
- ISO/IEC 15444-1:2004, JPEG 2000 Compression
- Annex 3 to the Convention on International Civil Aviation, Meteorological Services for International Navigation.
- Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications
- International Civil Aviation Organization Document 9855 Guidelines on the Use of the Public Internet for Aeronautical Applications

1.1.2. Industry Standards

- Institute of Electrical and Electronics Engineers (IEEE) 802.3: Ethernet Local Area Network Specification
- GNU Free Documentation License (http://www.gnu.org/software/wget/manual/wget.html - GNU-Free-Documentation-License)
- GNU Wget 1.12 Manual (http://www.gnu.org/software/wget/manual/wget.html)
- RFC 791: Internet Protocol (IP)
- RFC 793: Transmission Control Protocol (TCP)
- W3C Portable Network Graphics (PNG) Specification (Second Edition)

1.1.3. WAFC London Documents

- Secure Aviation Data Information Service (SADIS) User Guide (Part 1 and Part 2), Sixth Edition or current version: (http://www.icao.int/airnavigation/METP/MOG/Pages/SADIS.aspx)

2. Service Overview and Responsibilities of U.S. Government Agencies

WIFS is a real-time data repository of all OPMET data and WAFS products that are accessible via the Internet to authorized users. The provisions for requesting and approving user access are described in Section 4.

The FAA, as the U.S. Meteorological Authority, identifies the ICAO requirements for the products and services to be provided by the Washington WAFC. The National Oceanic and Atmospheric Administration (NOAA) NWS is the service provider of WAFS products and has agreed to manage and operate WIFS.

WIFS hosts the WAFS products and OPMET data on file servers on multiple geographically diverse web farms. This provides redundancy in case of a networking or system failure. If the primary farm goes down, users will be transparently moved to another farm. For timestamp consistency, only one farm is active at any time.

WIFS and SADIS also provide mutual backup support should there be a failure of either service or failure of user access to either service (see Figure 2-1 to determine areas designated primary for WIFS and SADIS). Section 4.3 describes the criteria for determining operational use and establishing backup service.

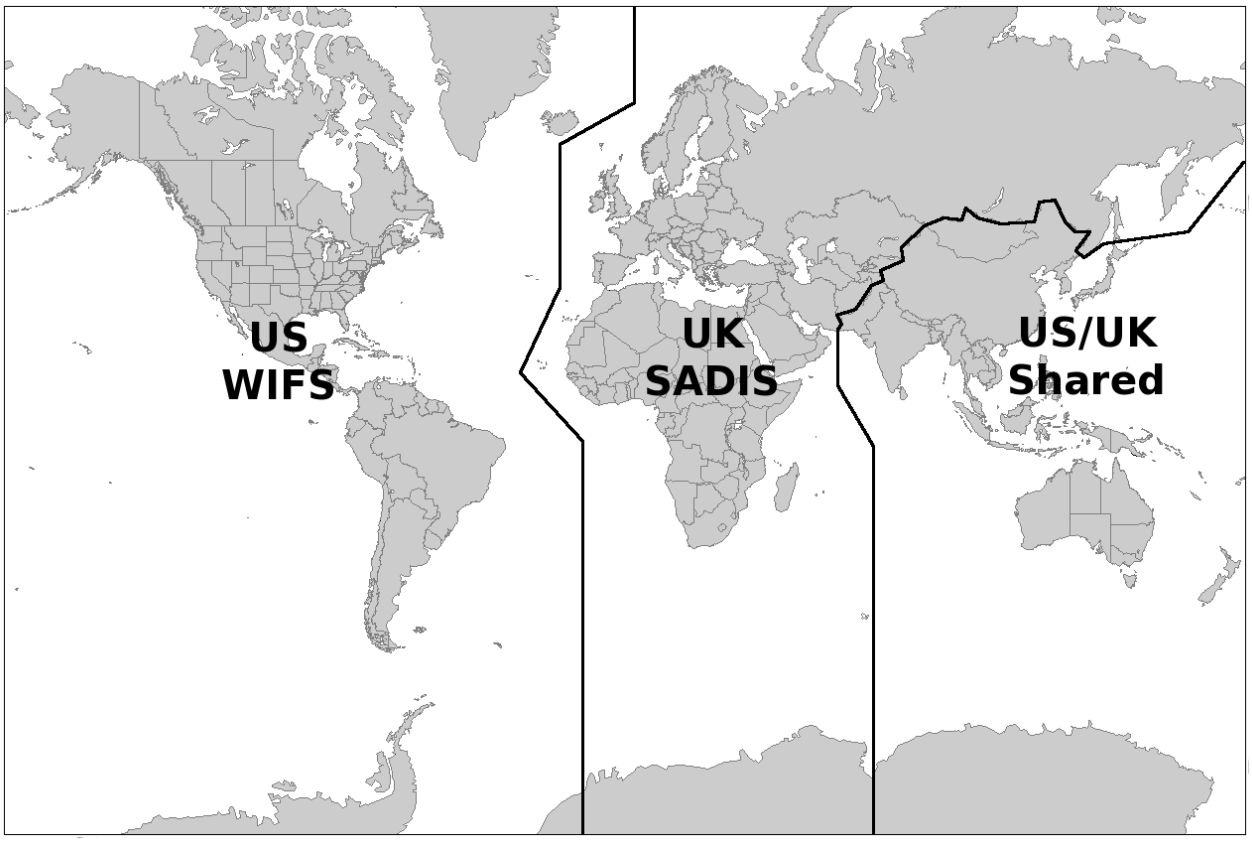


Figure 2-1 WIFS and SADIS Area Designations

3. Products and Data Available on WIFS

3.1. Overview of Service

WIFS provides access to WAFS products and OPMET data as defined in ICAO Annex 3, Meteorological Service for International Air Navigation, Chapter 3. These products are provided as follows:

- Grid Point data in GRIB2 format
- Significant Weather (SIGWX) in PNG and BUFR formats
- OPMET data in Alphanumeric format
- Volcanic Ash and Tropical Cyclone graphics in PNG format

3.2. Grid Point Data

WIFS provides upper-air gridded forecasts in GRIB2 format including WAFC Washington/WAFC London harmonized forecasts of cumulonimbus (CB) clouds, turbulence (both clear air and in cloud), and icing. Users retrieving this data must have a data processing system, such as the WAFS workstation, which can read, decode, and display the data.

Detailed information concerning upper-air gridded forecasts can be found in ICAO Annex 3, Appendix 2. Specific information related to WIFS gridded data can be found in Section 6.2 and Appendix C. WAFS Upper Air GRIB2 Details. Use Table 3-1 to determine when to expect data to be available.

Table 3-1 GRIB 2 Data Availability

Model Time (UTC)	Upper-Air Availability (UTC)*	Harmonized Data Availability (UTC)*
00	0345	0435
06	0945	1035
12	1545	1635
18	2145	2235

* The expected time under normal conditions. Factors out of our control (such as model delays, network sluggishness and higher than normal system loads) may delay these times by up to 30 minutes.

3.3. PNG Charts

SIGWX forecasts supplied in a Portable Network Graphics (PNG) format are issued four (4) times daily, and are valid at 0000, 0600, 1200, and 1800 UTC for the areas of coverage. The SIGWX forecasts include the elements listed in ICAO Annex 3, Appendix 2, section 1.3.3 (19th edition). Table 3-2 defines the forecast time and the availability of the SIGWX forecasts for use at a fixed schedule.

Table 3-2 SIGWX PNG Data Availability

Forecast Package Time (UTC)	PNG Availability (UTC)*
00	0700
06	1255
12	1850
18	0100

* The expected time under normal conditions. Factors out of our control (such as model delays, network sluggishness and higher than normal system loads) may delay these times by up to 30 minutes.

NOTE: Corrections of PNG graphics will show up with a "_CCA", "_CCB", etc., added to the filename after the center designator as in "20161012_1200_JUFE00_KWBC_CCA.png".

Volcanic ash and tropical cyclone graphics in PNG format are also available on WIFS. These products do not have a fixed schedule other than once the product is issued there are scheduled updates until the product is canceled. These PNG files contain the letters "PFXD" (volcanic ash) and "PZXD" (tropical cyclone) in the filename.

3.4. Significant Weather BUFR Files

SIGWX forecasts are issued using Binary Universal Form for the Representation of meteorological data (BUFR) code form follow the specifications included in WMO Publication No. 306, Manual on Codes, Volume I.2, Part B – Binary Codes. Forecasts of SIGWX prepared by WAFC Washington are issued four times daily, valid at 0000, 0600, 1200, and 1800 UTC. Table 3-3 defines the forecast time and the schedule of the availability of these files in a BUFR format.

Table 3-3 BUFR Data Availability

Forecast Package Time (UTC)	BUFR Availability (UTC)*
00	0700
06	1255
12	1850
18	0100

* The expected time under normal conditions. Factors out of our control (such as model delays, network sluggishness and higher than normal system loads) may delay these times by up to 30 minutes.

NOTE: Corrections of PNG graphics will show up with a "_CCA", "_CCB", etc., added to the filename after the center designator as in "20161012_1200_JUFE00_KWBC_CCA.bufr".

BUFR is a standard binary format approved by the WMO for efficient storage of meteorological features. To produce a BUFR file, two elements are needed: a raw data file and a set of tables containing descriptors. When raw data is encoded, each data value is attached to a descriptor defining what the data represents. The decoding process reads the BUFR file, looks up the descriptor in the relevant table, and writes out the information in the proper format. BUFR does not provide information on how to visually represent data. However, the WAFCs have written guidance on representation, which can be found on the WAFS Operations Group web page (http://www.icao.int/airnavigation/METP/MOG/Pages/default.aspx).

BUFR files contain a set of tables with descriptors. Descriptors must be decoded from a set of common tables on the local machine in order to understand what the values represent. To this end, BUFR messages are very small and machine independent. They can be understood and decoded by any BUFR decoder having the latest tables available.

SIGWX data in BUFR format is independent of the background or projection. Only the information describing the feature is encoded. For example, a CLOUD area is a list of points with the height of bases and tops, and cloud type and amount attributes attached. There are no rules on how the cloud area should be drawn, or how the attributes are displayed. On SIGWX charts this is

shown as a box, sometimes with an arrow to the area, but this information is determined by the graphical display program.

3.5. OPMET Alphanumeric Data

OPMET information includes Routine Aviation Weather Reports (METARs), Special Aviation Weather Reports (SPECIs), Terminal Aerodrome Forecasts (TAFs), Pilot Reports (PIREPs), Significant Meteorological Information (SIGMET) reports, Volcanic Ash Advisory (VAA) reports, and Tropical Cyclone Advisory (TCA) messages.

3.6. Administrative Messages

WIFS maintains a limited archive of administrative messages. See Table 3-4 for details. WIFS administrative messages may contain information on delayed data and products, updates to WIFS file structure and formats, and general information related to WAFS. (Section 6.6 has information on other means of communicating administrative messages.)

Table 3-4 Administrative Message Types

WMO Header	Description
FXUS65 KWBC and FXUK65 EGGR	These are used by the WAFCs to alert users to corrections to the WAFC charts
NOXX10 KKCI	These are WIFS administrative messages
NOXX10 KWBC	Notice of potential service outages
NOUS42 KWNO	Administrative messages from NCEP Central Operations
FXUS65	Notification of SIGWX corrections

3.7. Sources of WIFS Information Content

OPMET, forecasts and data products which are available to users on WIFS are found at:

- OPMET information (METAR, SPECI and TAF) - FASID Table MET 2A: http://www.icao.int/safety/meteorology/Documents/FASID%20Table%20MET%202A%20-%20SUG%20Annex%201%20-%20Complete.pdf
- WAFS forecasts - Same as SADIS access described in the SADIS Users Guide, Part 1, Annex 4 found at:

  http://www.icao.int/airnavigation/METP/MOG/Pages/SADIS.aspx

  Additional Aeronautical Meteorological Information - Same as described in the SADIS Users Guide, Part 1, Annex 5 (see link above) except for the following:
  - AIRMETS
  - GAMETS

  If an OPMET product is listed as being available under FASID Table MET 2A but cannot be found within the OPMET data files in WIFS, send an email to wifs.admin@noaa.gov to report the issue or report through the WIFS website:

http://aviationweather.gov/wifs/contact/index

4. WIFS User Authorization

The United States as a WAFS Provider State has agreed to support the operation of WAFC Washington along with the provision of making WAFS services available to all Contracting States as recognized in ICAO Regional Air Navigation Plans. WIFS is not an open system and requires all users to be approved for access by the:

- ICAO State Met Authority or the designated WIFS Approval Official registered with the ICAO Region, and
- FAA as the ICAO designated Meteorological Authority for the U.S. and as a WAFS Provider State.

WIFS access is restricted to those individuals (or activities) who support meteorological services for the conduct or development of international air navigation. The following categories of users may be provided access based on submission and approval of a WIFS Registration Form as described in Section 4.1:

- State MET Authority and designated representatives
- State National Meteorological & Hydrologic Service Providers including Volcanic Ash and Tropical Cyclone Advisory Centers
- State Units supporting air traffic services, search and rescue services, aeronautical information services
- International Air Carrier Operators
- Meteorological Service Provider Vendors which provide meteorological services for International Air Carrier Operators
- WAFS Workstation Vendors
- Other Aeronautical Users (i.e., Any entity that is deemed by the State and the WIFS Provider State to have a need for WAFS services.)
- SADIS Backup User

WIFS Users are advised that their account may be terminated if it is determined the account is being used for purposes other than the original intent in support of international air navigation.

4.1. WIFS Registration

Approving an applicant request for access to WIFS requires submission and processing of a WIFS Registration Form as outlined in the following steps:

Applicant (Completes Steps 1 and 2):

1. Determines whether WIFS or SADIS is the primary service for obtaining WAFS forecasts for operational use as required in ICAO Regional Air Navigation Plans (RANPs) for their location. (See Figure 2-1: WIFS and SADIS Area Designations).

   NOTE: WIFS provides primary service for North American, Central America, and Caribbean (NACC); and South America (SAM) Regions. WIFS and SADIS share primary responsibility in the Asia and Pacific (APAC) region as listed in the APAC FASID Table 6 (http://www.icao.int/APAC/Pages/edocs-fasid.aspx). Section 4.3 provides further

background on factors related to establishing SADIS and WIFS operational and backup accounts.

2. Completes and submits the WIFS Registration form online (http://www.aviationweather.gov/wifs). Fields on the form with an (*) are required. Failure to provide accurate information may result in a processing delay or denial of a WIFS account.

   Comments Section: Include a description of the intended use of the WIFS service indicating how that use relates to developing or conducting meteorological services supporting international air navigation.

FAA (Completes Steps 3 & 4 as the WIFS Approval Authority):

3. Reviews the WIFS Registration request and confirms the State Approval and/or the status of an existing SADIS account if the WIFS access is for SADIS backup.
4. Approves (or denies) the Registration request.

NWS/AWC (Completes Step 5 as the WIFS service provider):

5. Advises the Applicant of the status. If approved, issues a Password and User Name; and adds the applicant as an approved WIFS User (primary or backup).

Figure 4-1 shows a snapshot of the current WIFS Registration Form available on the WIFS home page. Upon completion of the registration form, a confirmation screen will be displayed showing that the account was successfully submitted for approval. Review and approval processing normally takes 15-20 business days.

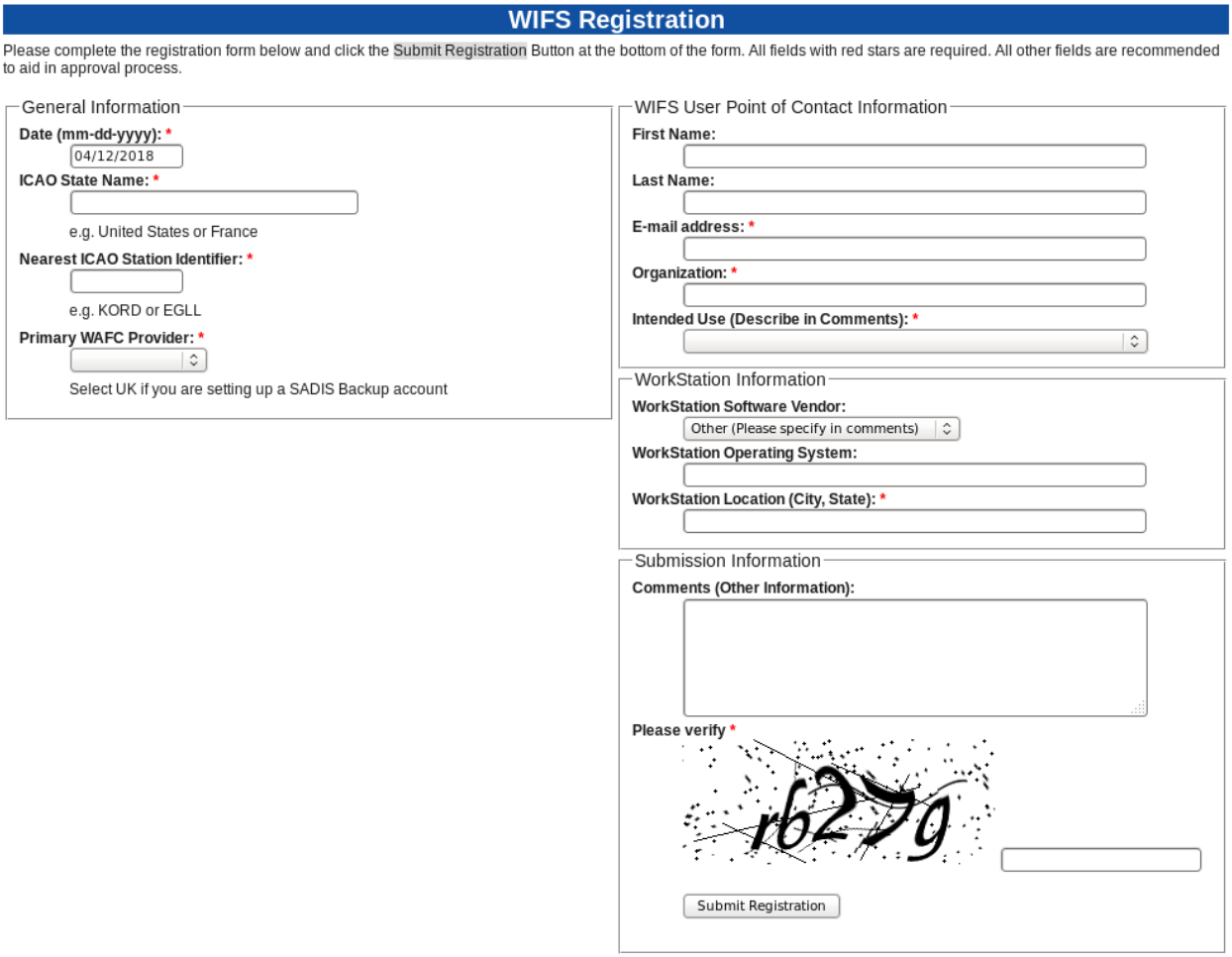


Figure 4-1 WIFS Registration Form

4.2. WIFS Password Policy

The current password policy is that the password does not expire. Users may request a password change by submitting an updated Registration request, and adding an applicable comment in the Comments (Other Information) field.

4.3. Determining Operational and Backup Service Use

In order for the SADIS and WIFS providers to appropriately manage and maintain viable, mutually existing services delivering WAFS forecasts, the following process should be followed within a particular State in arranging to obtain their data.

For Primary Operational Use (see Figure 2-1 **Error! Reference source not found.**) from:

A. WIFS Primary Use:

- Applicants become approved WIFS Users; follow the procedures in Section 4.1 for establishing a WIFS account.

- SADIS accounts will be provided to authorized WIFS users by the SADIS Provider State for backup purposes on condition that:
    - A WIFS account has been authorized and provided;
    - SADIS use is restricted to backup purposes and periodic testing. (See paragraph 4.4 below.)
    - Follow procedures as described on the SADIS website (http://www.metoffice.gov.uk/aviation/sadis/procure).

  NOTE: Cost recovery is not required for a backup account provided the SADIS procedures are followed. Additional background is available in the SADIS User Guide/Part 1 (http://www.icao.int/airnavigation/METP/MOG/Pages/SADIS.aspx).

B. SADIS Primary Use:

- Applicants become approved SADIS Users and participate in the SADIS cost recovery scheme as described in the SADIS User Guide.
- WIFS accounts will be provided to authorized SADIS users by the WIFS Provider State for backup purposes on condition that:
    - A SADIS account has been authorized and provided;
    - There are no outstanding balances in respect of the SADIS cost recovery scheme and
    - That use is restricted to backup purposes and periodic testing. (See paragraph 4.4 below.)

C. Either SADIS or WIFS Primary Use:

For requests coming from the ICAO APAC Region, the State determines which of the two services (SADIS or WIFS) to obtain their primary operational access to WAFS forecasts; follow the appropriate procedures in subsections A or B above.

D. Both SADIS and WIFS Primary Use:

In exceptional circumstances, States that have an operational requirement to obtain data from both WIFS and SADIS on a continuous basis will have their requests considered on a case-by-case basis. Under such circumstances a State taking both services will be required to contribute fully to the SADIS cost recovery scheme (unless recognized as a United Nations Least Developed Country).

4.4. WIFS Backup to SADIS

The definition of the threshold for operational versus backup purposes to be used on the SADIS and WIFS Internet-based services was defined and endorsed by the ICAO SADIS Operations Group (SADISOPSG) and is described in the notes below. The policy limits backup access to a maximum of one day in seven. In the event of unavailability of the SADIS service, unlimited access to WIFS will be granted until the SADIS service has been restored.

Note 1.—The specific days/times States/users wish to test their accounts is at the State/user's discretion so long as it does not exceed once every seven days.

Note 2.— Backup accounts will be maintained in a "live" status in order that immediate access is available in the event of a genuine need to access the alternative Provider's service for backup purposes.

Note 3.— The SADIS and WIFS Providers will monitor their services to determine user access behavior.

Note 4.— It remains the sole responsibility of the State/user to determine if they require a backup account from the alternative Provider, and if so, to arrange for that account.

4.5. Suspension of Access

WIFS access may be suspended by the WIFS approving authority for unauthorized use of WIFS. Access to SADIS and WIFS as back-up services may be suspended by the WIFS and SADIS approving authorities if user's primary WIFS or SADIS accounts are suspended.

5. Data Retrieval Process

WIFS does not deliver ("push") data to the user but requires the user to collect ("pull") data off the file servers. User access to the WIFS files servers is by a Secure Hypertext Transfer Protocol (HTTPS) session over the Internet. Files can be downloaded across this secure connection using an Internet browser or software tools such as GNU wget. The wget tool is freely available and designed to retrieve content from web-based file servers. More information about how to use WIFS and wget can be found in Appendices A and B.

The minimum recommended Internet connection speed is 64 kbps for OPMET, BUFR and PNG data. The minimum connection speed for GRIB2 data is 512 kbps. Once the data are retrieved from WIFS, users will need software that is capable of processing and displaying WAFS data. A list of WAFS software providers can be found on the Vendors page at http://www.aviationweather.gov/wifs. Users should contact specific providers for cost and availability.

WIFS users access the WIFS file servers using the https://www.aviationweather.gov/wifs/data URL.

6. WIFS Directory Structure and File Formats

Figure 6-1 depicts the WIFS directory structure and the names of the individual folders, with respect to the base URL (e.g., https://www.aviationweather.gov/wifs/data).

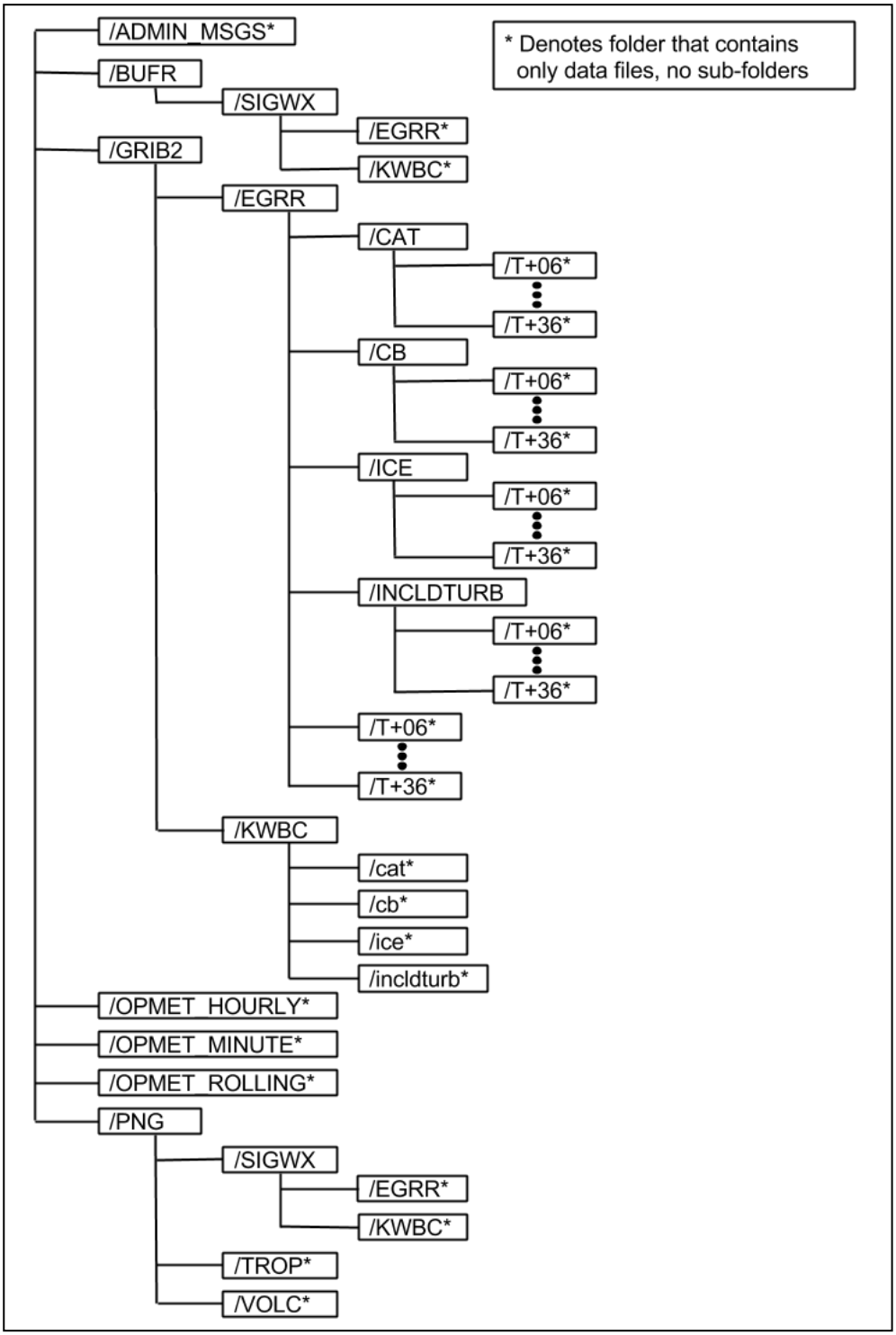
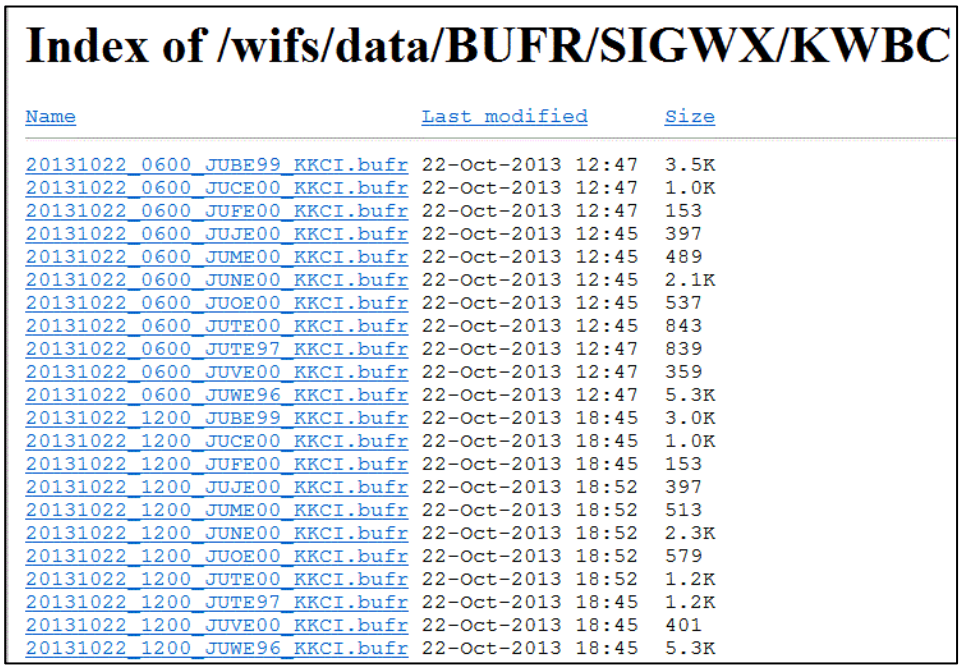


Figure 6-1 WIFS Directory Structure

6.1. BUFR Files

The BUFR files are generated every 6 hours and the WIFS BUFR folder contains the past 36 hours of SIGWX forecasts in BUFR format. Figure 6-2 is an example of the files that can be found in this folder.



Index of /wifs/data/BUFR/SIGWX/KWBC

Name	Last modified	Size
20131022_0600_JUBE99_KKCI.bufr	22-Oct-2013 12:47	3.5K
20131022_0600_JUCE00_KKCI.bufr	22-Oct-2013 12:47	1.0K
20131022_0600_JUFE00_KKCI.bufr	22-Oct-2013 12:47	153
20131022_0600_JUJE00_KKCI.bufr	22-Oct-2013 12:45	397
20131022_0600_JUME00_KKCI.bufr	22-Oct-2013 12:45	489
20131022_0600_JUNE00_KKCI.bufr	22-Oct-2013 12:45	2.1K
20131022_0600_JUOE00_KKCI.bufr	22-Oct-2013 12:45	537
20131022_0600_JUTE00_KKCI.bufr	22-Oct-2013 12:45	843
20131022_0600_JUTE97_KKCI.bufr	22-Oct-2013 12:47	839
20131022_0600_JUVE00_KKCI.bufr	22-Oct-2013 12:47	359
20131022_0600_JUWE96_KKCI.bufr	22-Oct-2013 12:47	5.3K
20131022_1200_JUBE99_KKCI.bufr	22-Oct-2013 18:45	3.0K
20131022_1200_JUCE00_KKCI.bufr	22-Oct-2013 18:45	1.0K
20131022_1200_JUFE00_KKCI.bufr	22-Oct-2013 18:45	153
20131022_1200_JUJE00_KKCI.bufr	22-Oct-2013 18:52	397
20131022_1200_JUME00_KKCI.bufr	22-Oct-2013 18:52	513
20131022_1200_JUNE00_KKCI.bufr	22-Oct-2013 18:52	2.3K
20131022_1200_JUOE00_KKCI.bufr	22-Oct-2013 18:52	579
20131022_1200_JUTE00_KKCI.bufr	22-Oct-2013 18:52	1.2K
20131022_1200_JUTE97_KKCI.bufr	22-Oct-2013 18:45	1.2K
20131022_1200_JUVE00_KKCI.bufr	22-Oct-2013 18:45	401
20131022_1200_JUWE96_KKCI.bufr	22-Oct-2013 18:45	5.3K

Figure 6-2 Snapshot of the BUFR folder

The file naming convention for these files is:

YYYYMMDD_HH00_TTAAii_CCCC.bufr where

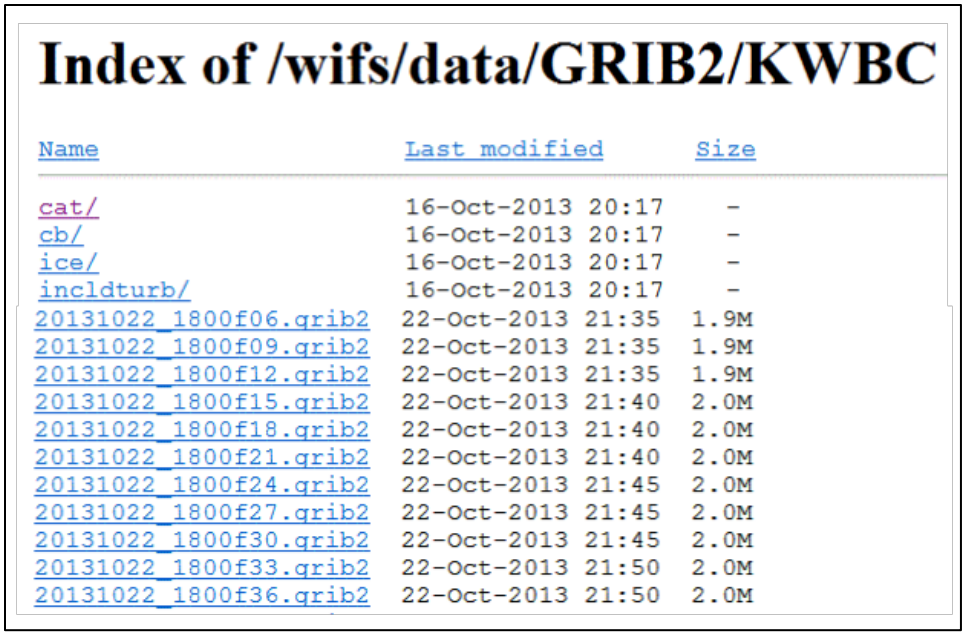
YYYY	=	4-digit year
MM	=	2-digit month
DD	=	2-digit day
HH	=	2-digit hour of forecast package valid time
00	=	Fixed characters
TTAAii_CCCC	=	WMO header and site identifier
.bufr	=	File extension

6.1.1. Format of BUFR Files

For details on the format of the BUFR products see WMO Publication FM94 BUFR.

6.2. GRIB2 Gridded Files

The WAFS GRIB2 files are generated every 6 hours. The GRIB2 folder contains all the forecasts from the past 18 hours. The individual bulletins are concatenated together according to the forecast valid time. Figure 6-3 depicts an example of the files that can be found under the GRIB2 folder.



Index of /wifs/data/GRIB2/KWBC

Name	Last modified	Size
cat/	16-Oct-2013 20:17	-
cb/	16-Oct-2013 20:17	-
ice/	16-Oct-2013 20:17	-
incldturb/	16-Oct-2013 20:17	-
20131022_1800f06.grib2	22-Oct-2013 21:35	1.9M
20131022_1800f09.grib2	22-Oct-2013 21:35	1.9M
20131022_1800f12.grib2	22-Oct-2013 21:35	1.9M
20131022_1800f15.grib2	22-Oct-2013 21:40	2.0M
20131022_1800f18.grib2	22-Oct-2013 21:40	2.0M
20131022_1800f21.grib2	22-Oct-2013 21:40	2.0M
20131022_1800f24.grib2	22-Oct-2013 21:45	2.0M
20131022_1800f27.grib2	22-Oct-2013 21:45	2.0M
20131022_1800f30.grib2	22-Oct-2013 21:45	2.0M
20131022_1800f33.grib2	22-Oct-2013 21:50	2.0M
20131022_1800f36.grib2	22-Oct-2013 21:50	2.0M

Figure 6-3 Snapshot of the GRIB2 folder

The file naming convention for GRIB2 files is:

YYYYMMDD_hhmmfFF.grib2 where

YYYY	=	4-digit year
MM	=	2-digit month
DD	=	2-digit day
hh	=	2-digit hour of model run
mm	=	2-digit minute of model run
f	=	Fixed character
FF	=	2-digit forecast hour
.grib2	=	File extension

6.2.1. Format of Gridded Files

The gridded files are formatted in accordance with WMO code FM 92 (GRIB Version 2), and are described in full detail in "WMO Manual on Codes, Volume I, Part B (WMO No. 306).

Software libraries to decode data in GRIB2 data are provided by the National Centers for Environmental Prediction (NCEP), and can be found at:

http://www.nco.ncep.noaa.gov/pmb/codes/GRIB2/

6.3. OPMET Data Files

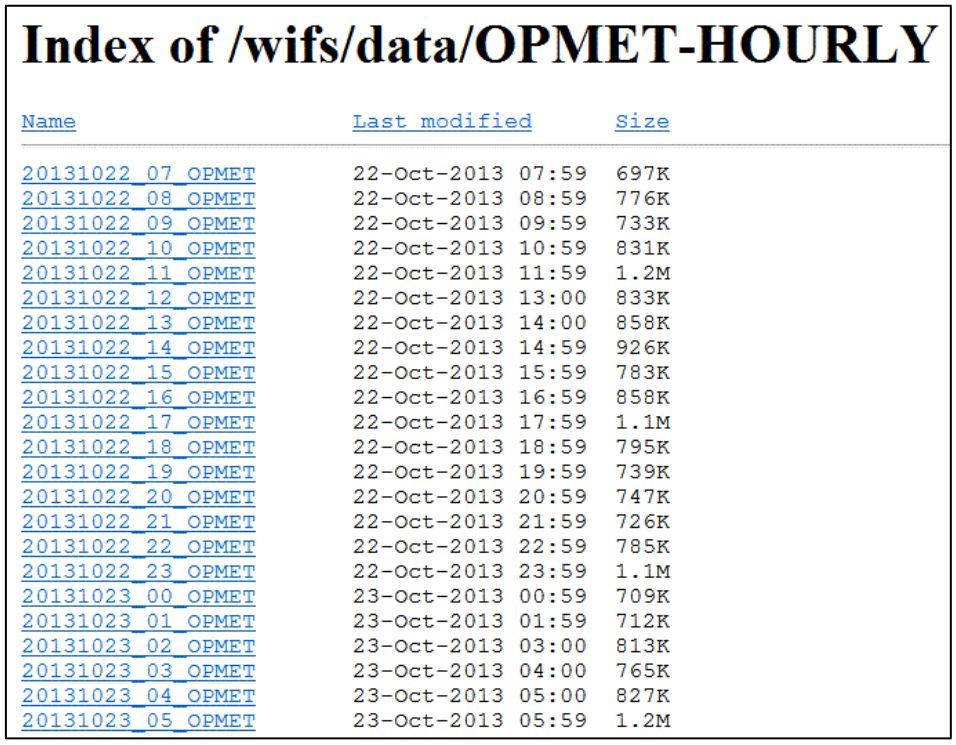
The WIFS servers provide OPMET data (METARs/SPECIs, TAFs, SIGMETs, Advisories, PIREPs) in character-oriented format, and these data are made available based on the following criteria:

- By the Hour
- By the Minute

- Rolling timeframes of the last 5, 30 and 60 minutes

6.3.1. OPMET-HOURLY

Each file within this folder contains all OPMET data that was received by NWS during a given hour. 36 hours of data are continuously maintained, and every hour a new file is generated from the most recent hour's data, and the oldest file is removed from the WIFS server. Figure 6-4 depicts a snapshot of the files maintained in this folder.



Index of /wifs/data/OPMET-HOURLY

Name	Last modified	Size
20131022_07_OPMET	22-Oct-2013 07:59	697K
20131022_08_OPMET	22-Oct-2013 08:59	776K
20131022_09_OPMET	22-Oct-2013 09:59	733K
20131022_10_OPMET	22-Oct-2013 10:59	831K
20131022_11_OPMET	22-Oct-2013 11:59	1.2M
20131022_12_OPMET	22-Oct-2013 13:00	833K
20131022_13_OPMET	22-Oct-2013 14:00	858K
20131022_14_OPMET	22-Oct-2013 14:59	926K
20131022_15_OPMET	22-Oct-2013 15:59	783K
20131022_16_OPMET	22-Oct-2013 16:59	858K
20131022_17_OPMET	22-Oct-2013 17:59	1.1M
20131022_18_OPMET	22-Oct-2013 18:59	795K
20131022_19_OPMET	22-Oct-2013 19:59	739K
20131022_20_OPMET	22-Oct-2013 20:59	747K
20131022_21_OPMET	22-Oct-2013 21:59	726K
20131022_22_OPMET	22-Oct-2013 22:59	785K
20131022_23_OPMET	22-Oct-2013 23:59	1.1M
20131023_00_OPMET	23-Oct-2013 00:59	709K
20131023_01_OPMET	23-Oct-2013 01:59	712K
20131023_02_OPMET	23-Oct-2013 03:00	813K
20131023_03_OPMET	23-Oct-2013 04:00	765K
20131023_04_OPMET	23-Oct-2013 05:00	827K
20131023_05_OPMET	23-Oct-2013 05:59	1.2M

Figure 6-4 Snapshot of the OPMET-Hourly Folder

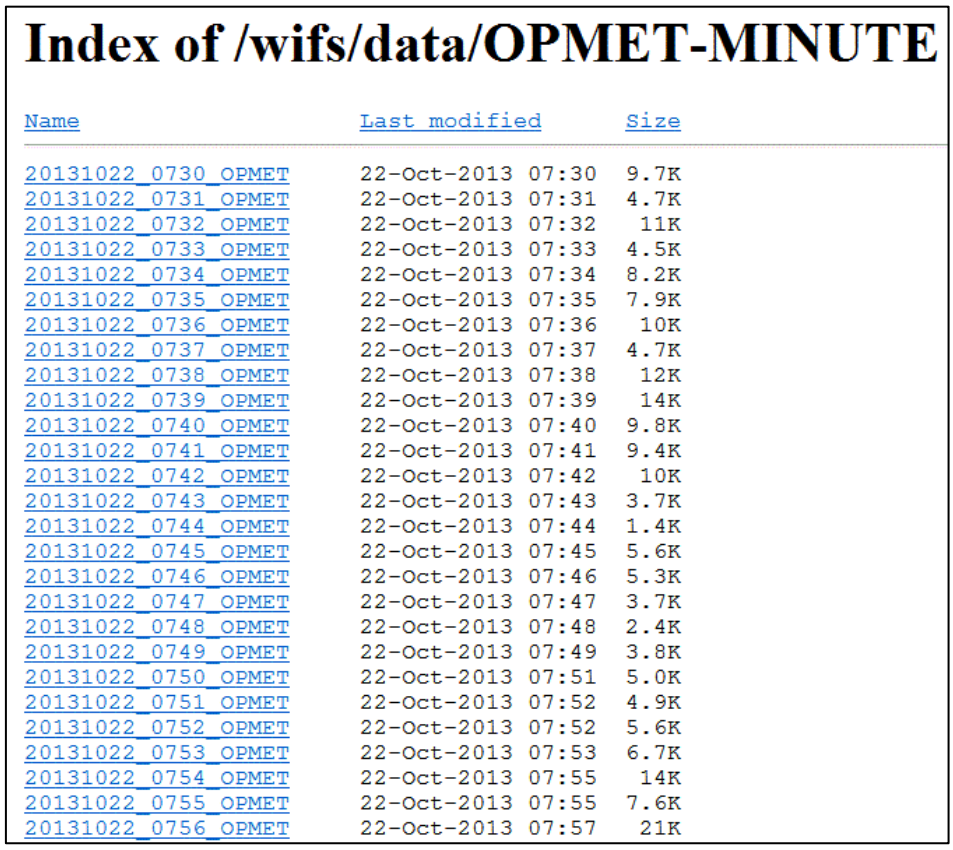
The file naming convention for OPMET-HOURLY files is:

YYYYMMDD_hh_OPMET where

YYYY	=	4-digit year
MM	=	2-digit month
DD	=	2-digit day
hh	=	2-digit start hour of collected data
OPMET	=	Fixed text

6.3.2. OPMET-MINUTE

Each file within this folder contains all OPMET data received during a given minute. Thirty-six (36) hours of data are continuously maintained. Every minute a new file is generated from the most recent hour's data and the oldest file is removed. Figure 6-5 depicts a snapshot of the files maintained in this folder.



Index of /wifs/data/OPMET-MINUTE

Name	Last modified	Size
20131022_0730_OPMET	22-Oct-2013 07:30	9.7K
20131022_0731_OPMET	22-Oct-2013 07:31	4.7K
20131022_0732_OPMET	22-Oct-2013 07:32	11K
20131022_0733_OPMET	22-Oct-2013 07:33	4.5K
20131022_0734_OPMET	22-Oct-2013 07:34	8.2K
20131022_0735_OPMET	22-Oct-2013 07:35	7.9K
20131022_0736_OPMET	22-Oct-2013 07:36	10K
20131022_0737_OPMET	22-Oct-2013 07:37	4.7K
20131022_0738_OPMET	22-Oct-2013 07:38	12K
20131022_0739_OPMET	22-Oct-2013 07:39	14K
20131022_0740_OPMET	22-Oct-2013 07:40	9.8K
20131022_0741_OPMET	22-Oct-2013 07:41	9.4K
20131022_0742_OPMET	22-Oct-2013 07:42	10K
20131022_0743_OPMET	22-Oct-2013 07:43	3.7K
20131022_0744_OPMET	22-Oct-2013 07:44	1.4K
20131022_0745_OPMET	22-Oct-2013 07:45	5.6K
20131022_0746_OPMET	22-Oct-2013 07:46	5.3K
20131022_0747_OPMET	22-Oct-2013 07:47	3.7K
20131022_0748_OPMET	22-Oct-2013 07:48	2.4K
20131022_0749_OPMET	22-Oct-2013 07:49	3.8K
20131022_0750_OPMET	22-Oct-2013 07:51	5.0K
20131022_0751_OPMET	22-Oct-2013 07:52	4.9K
20131022_0752_OPMET	22-Oct-2013 07:52	5.6K
20131022_0753_OPMET	22-Oct-2013 07:53	6.7K
20131022_0754_OPMET	22-Oct-2013 07:55	14K
20131022_0755_OPMET	22-Oct-2013 07:55	7.6K
20131022_0756_OPMET	22-Oct-2013 07:57	21K

Figure 6-5 Snapshot of the OPMET-MINUTE folder

The file naming convention for OPMET-MINUTE files is:

YYYYMMDD_hhmm_OPMET where

YYYY	=	4-digit year
MM	=	2-digit month
DD	=	2-digit day
hh	=	2-digit start hour of collected data
mm	=	2-digit start minute within the hh hour of collected data
OPMET	=	Fixed text

6.3.3. OPMET-ROLLING

There are five individual OPMET data files within this folder that are generated from the OPMET_MINUTE files.

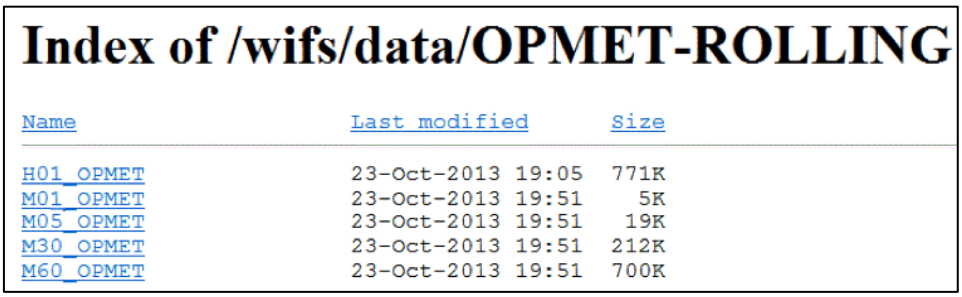


Figure 6-6 Snapshot of the OPMET-ROLLING folder

- The M01_OPMET file updates every minute and contains the latest minute of OPMET data.
- The M05_OPMET file updates every minute and contains the latest 5 minutes of OPMET data.
- The M30_OPMET file updates every minute and contains the latest 30 minutes of OPMET data.
- The M60_OPMET file updates every minute and contains the latest 60 minutes of OPMET data.
- The H01_OPMET file updates just after the top of the hour and contains the previous 60 minutes of OPMET data updated at the top of the hour.

6.3.4. Format of OPMET Files

The OPMET files contain multiple WMO records are formatted in accordance with WMO Publication 386.

6.4. PNG Files

Portable Network Graphic (PNG) images of the Significant Weather ICAO area charts are stored in the PNG folder of the WIFS file system. The WMO messages in Table 6-1 are retained in the PNG folder for 36 hours. Additional information pertaining to the areas referenced in Table 6-1 can be found in Figure 6-7.

Table 6-1 Significant Weather PNG Files

WMO Header	Area
PGEE05 KKCI	ICAO A
PGIE05 KKCI	ICAO B1
PGGE05 KKCI	ICAO F
PGAE05 KKCI	ICAO H
PGBE05 KKCI	ICAO I
PGJE05 KKCI	ICAO J
PGDE29 KKCI	ICAO M
PGNE14 KKCI	North Atlantic Ocean Region

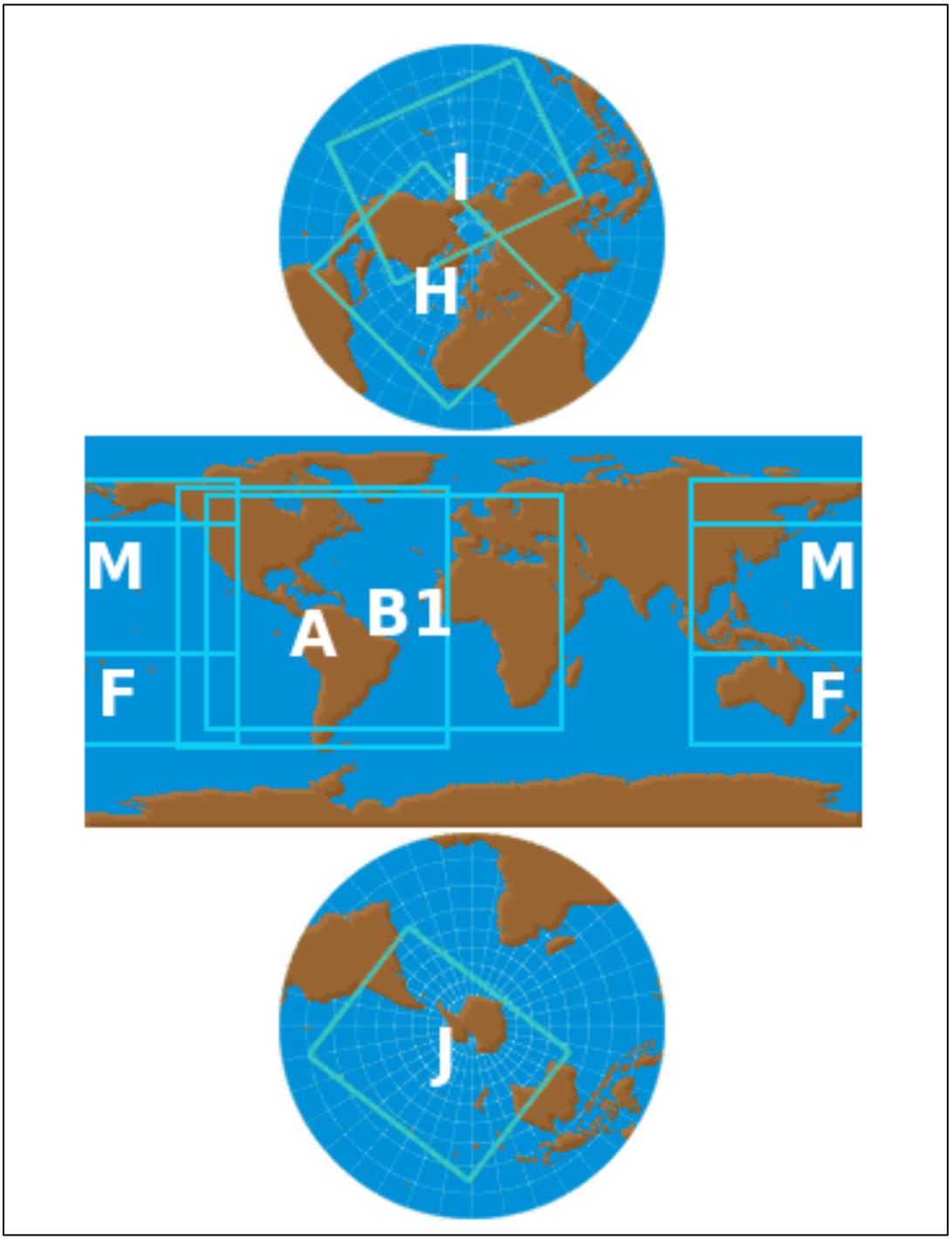
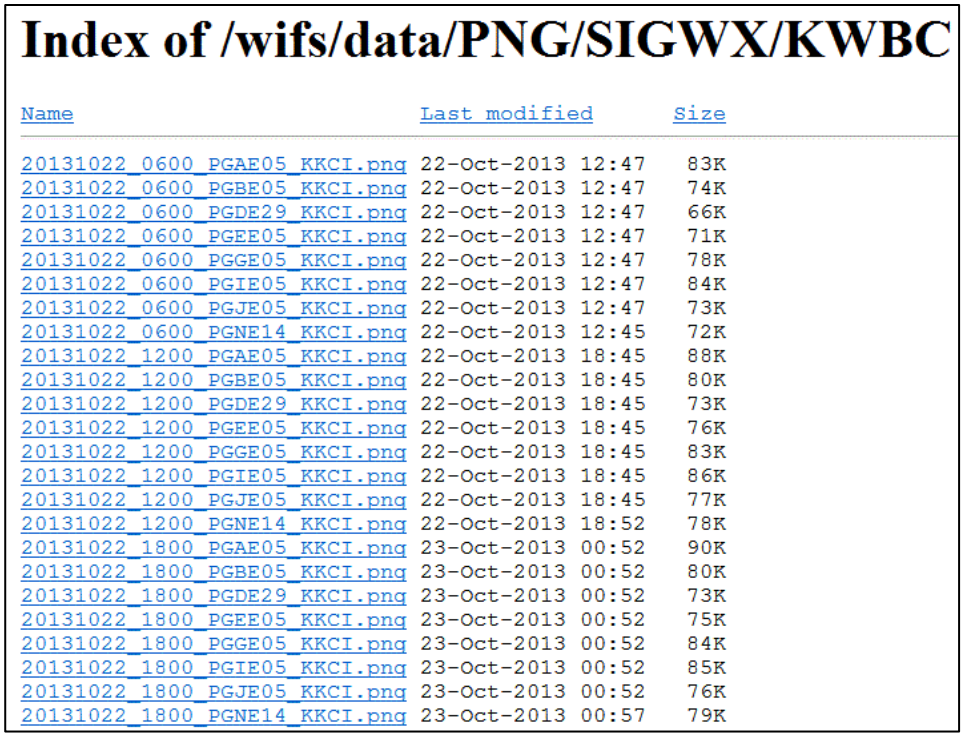


Figure 6-7 ICAO Regions

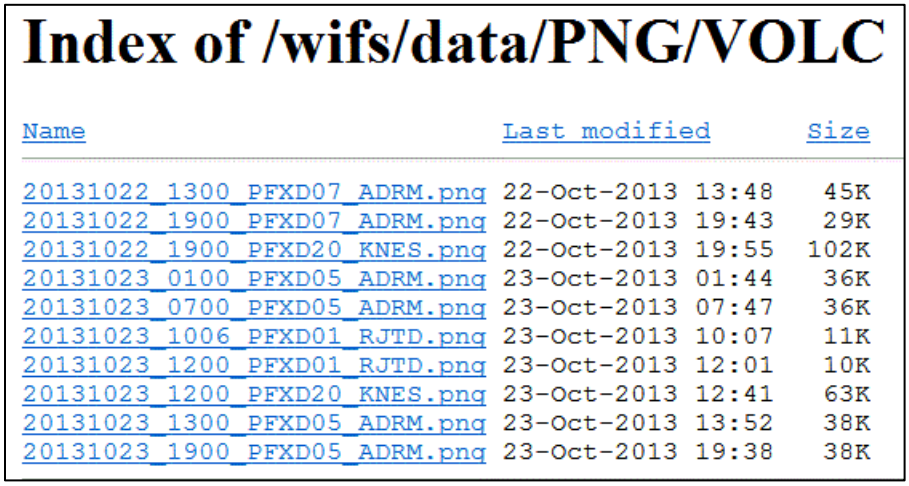
Volcanic ash and tropical cyclone graphics in PNG format are also available when advisories are issued. These products will have a WMO header starting with PFXD (volcanic ash) and PZXD (tropical cyclone). Figure 6-8 and Figure 6-9 depict snapshots of the files maintained in the SIGWX and VOLC folders, respectively.



Index of /wifs/data/PNG/SIGWX/KWBC

Name	Last modified	Size
20131022_0600_PGAE05_KKCI.png	22-Oct-2013 12:47	83K
20131022_0600_PGBE05_KKCI.png	22-Oct-2013 12:47	74K
20131022_0600_PGDE29_KKCI.png	22-Oct-2013 12:47	66K
20131022_0600_PGEE05_KKCI.png	22-Oct-2013 12:47	71K
20131022_0600_PGGE05_KKCI.png	22-Oct-2013 12:47	78K
20131022_0600_PGIE05_KKCI.png	22-Oct-2013 12:47	84K
20131022_0600_PGJE05_KKCI.png	22-Oct-2013 12:47	73K
20131022_0600_PGNE14_KKCI.png	22-Oct-2013 12:45	72K
20131022_1200_PGAE05_KKCI.png	22-Oct-2013 18:45	88K
20131022_1200_PGBE05_KKCI.png	22-Oct-2013 18:45	80K
20131022_1200_PGDE29_KKCI.png	22-Oct-2013 18:45	73K
20131022_1200_PGEE05_KKCI.png	22-Oct-2013 18:45	76K
20131022_1200_PGGE05_KKCI.png	22-Oct-2013 18:45	83K
20131022_1200_PGIE05_KKCI.png	22-Oct-2013 18:45	86K
20131022_1200_PGJE05_KKCI.png	22-Oct-2013 18:45	77K
20131022_1200_PGNE14_KKCI.png	22-Oct-2013 18:52	78K
20131022_1800_PGAE05_KKCI.png	23-Oct-2013 00:52	90K
20131022_1800_PGBE05_KKCI.png	23-Oct-2013 00:52	80K
20131022_1800_PGDE29_KKCI.png	23-Oct-2013 00:52	73K
20131022_1800_PGEE05_KKCI.png	23-Oct-2013 00:52	75K
20131022_1800_PGGE05_KKCI.png	23-Oct-2013 00:52	84K
20131022_1800_PGIE05_KKCI.png	23-Oct-2013 00:52	85K
20131022_1800_PGJE05_KKCI.png	23-Oct-2013 00:52	76K
20131022_1800_PGNE14_KKCI.png	23-Oct-2013 00:57	79K

Figure 6-8 Snapshot of the PNG SIGWX KWBC folder



Index of /wifs/data/PNG/VOLC

Name	Last modified	Size
20131022_1300_PFXD07_ADRM.png	22-Oct-2013 13:48	45K
20131022_1900_PFXD07_ADRM.png	22-Oct-2013 19:43	29K
20131022_1900_PFXD20_KNES.png	22-Oct-2013 19:55	102K
20131023_0100_PFXD05_ADRM.png	23-Oct-2013 01:44	36K
20131023_0700_PFXD05_ADRM.png	23-Oct-2013 07:47	36K
20131023_1006_PFXD01_RJTD.png	23-Oct-2013 10:07	11K
20131023_1200_PFXD01_RJTD.png	23-Oct-2013 12:01	10K
20131023_1200_PFXD20_KNES.png	23-Oct-2013 12:41	63K
20131023_1300_PFXD05_ADRM.png	23-Oct-2013 13:52	38K
20131023_1900_PFXD05_ADRM.png	23-Oct-2013 19:38	38K

Figure 6-9 Snapshot of the PNG VOLC folder

The file naming convention for these files is:

YYYYMMDD_HH00_TTAAii_CCCC.png where

YYYY	=	4-digit year
MM	=	2-digit month
DD	=	2-digit day
HH	=	2-digit hour of forecast package valid time
00	=	Fixed characters

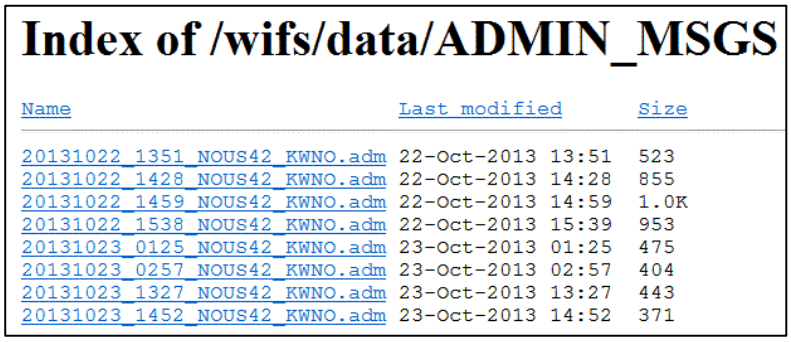
TTAAii_CCCC	=	WMO header and site identifier
.png	=	File extension

6.4.1. Format of PNG Files

For detailed information on the PNG format, see the W3C Portable Network Graphics (PNG) Specification (Second Edition) (http://www.w3.org/TR/PNG).

6.5. ADMIN_MSGS

Administrative messages are retained on WIFS for 36 hours. Each file contains a single message. Figure 6-10 is a snapshot of the administrative messages found on the WIFS servers.



Index of /wifs/data/ADMIN_MSGS

Name	Last modified	Size
20131022_1351_NOUS42_KWNO.adm	22-Oct-2013 13:51	523
20131022_1428_NOUS42_KWNO.adm	22-Oct-2013 14:28	855
20131022_1459_NOUS42_KWNO.adm	22-Oct-2013 14:59	1.0K
20131022_1538_NOUS42_KWNO.adm	22-Oct-2013 15:39	953
20131023_0125_NOUS42_KWNO.adm	23-Oct-2013 01:25	475
20131023_0257_NOUS42_KWNO.adm	23-Oct-2013 02:57	404
20131023_1327_NOUS42_KWNO.adm	23-Oct-2013 13:27	443
20131023_1452_NOUS42_KWNO.adm	23-Oct-2013 14:52	371

Figure 6-10 Snapshot of the ADMIN_MSGS folder

The file naming convention for these files is:

YYYYMMDD_hhmm_TTAAii_CCCC.adm where

YYYY	=	4-digit year
MM	=	2-digit month
DD	=	2-digit day
hh	=	2-digit hour of message issuance time
mm	=	2-digit minute of message issuance time
TTAAii_CCCC	=	WMO header and site identifier
.adm	=	File extension

6.5.1. Format of Administrative Message Files

The Administrative message files contain a single WMO record formatted in accordance with WMO Publication 386.

6.6. Announcing Changes in Services or Products

Any routine changes to the WIFS Directory structure, content, or the formats of the WIFS files will be communicated at least 30 days in advance of the scheduled implementation via an "NOXX10 KKCI" Administrative message and to the user's registered email on file. In addition, requirement changes that are agreed upon and announced at the ICAO Met Panel (Working Group-Meteorological Operations Group) and other regional meetings may result in modifications to the file content and data structure. Examples of new WIFS content and formats

will be made available for WIFS User testing to identify any impacts to user WIFS processing or display systems.

WIFS Customer Support will be available to assist WIFS Users in resolving any issues with user logins, data timeliness, and network outages.

7. WIFS Support Web Site

The WIFS support website can be accessed by opening the following link in a web browser: http://www.aviationweather.gov/wifs.

The intent of this web site is to provide users with an online portal for information pertaining to WIFS. The web site has the following key capabilities:

- Online registration
- Access to the latest Users Guide
- List of available products
- Contact information
- Troubleshooting tips
- WAFS software vendor information
- Advisories containing the operational status of WIFS and any other news-worthy information

8. WIFS Help Desk

The WIFS Help Desk is available to address issues Monday through Friday between the hours of 7am to 3:30pm US Central Time. To contact the WIFS Help Desk:

E-mail: wifs.admin@noaa.gov

Phone: +1 (877) 280-2811

For operational issues outside of normal WIFS Help Desk hours, users can leave a voice mail, send an email, or submit an on line form (http://www.aviationweather.gov/wifs/contact) and can generally expect a response within 3 hours after the Help Desk re-opens. For each operational issue identified, a service ticket will be generated and users will be sent an e-mail with the service ticket number. Users should refer to this ticket number in all follow-up correspondence with the WIFS Help Desk.

If users require immediate help outside of normal business hours they should contact the NWS Telecommunications Operations Center Help Desk at +1 (301) 713-0902.

9. User Troubleshooting Guidelines

Table 9-1 provides an initial set of troubleshooting guidelines to help users with possible issues. This information can also be found on the WIFS Support web-site which may be updated with more troubleshooting guidelines.

Table 9-1 Troubleshooting Guidelines

Symptom	Probable Cause	Actions to Take
Data are out of date, cannot be retrieved, is not being properly displayed, or missing on the workstation	WAFS data retrieve process failed	Test the internet connection[1]
		Check the data retrieve log file for errors[2]
		Contact the WAFS workstation support team
	Data on WIFS is out of date	Test the internet connection[1]
		Browse to the WIFS online file list and check to see if data are up to date[3]
		If data are out of date send an email to wifs.admin@noaa.gov and contact the NWSTG to report the problem.[4]
	There is a WIFS data ingest problem	Check the Advisories page for new advisories pertaining to data outages.
		If data are out of date send an email to wifs.admin@noaa.gov and contact the NWSTG to report the problem.[4]

Notes:

1. To test your internet connection, try to connect to a known website on your browser. If it does not connect, contact your system administrator or your Internet Service Provider for assistance.
2. If you do not know where this file is or how to access it, contact the WAFS Workstation Support Team.
3. In your browser type in the WIFS URL (i.e., http://www.aviationweather.gov/wifs). Click on the appropriate category and find the data you are looking for. Take note of the file name with the latest date/time.
4. The National Weather Service Telecommunications Gateway (NWSTG) Helpdesk phone number is +1 (301) 713-0902.

Appendix A. Using WIFS

Once you are authorized to use WIFS (see Section 4) you can begin downloading data at any time. The basic technical requirement for using WIFS is a computer system equipped with the following components:

1. Connection to the public Internet
2. Software capable of issuing Hypertext Transfer Protocol Secure (HTTPS) GET commands to download the data (see Appendix B for details about the recommended software GNU wget).
3. Sufficient storage to store the products you want to download.
4. Software capable of reading, decoding, displaying, and manipulating the data according to the user's specific purpose. To see a list of software providers, point your browser to http://www.aviationweather.gov/wifs and click on Vendors.

Use Case Example 1 – Downloading a single file using the web browser

Below is a use-case scenario for how a fictitious user (John Smith) identifies a single file he wants and uses his web browser to download it from WIFS. In this case, John knows he wants a Significant Weather PNG chart.

1. Using his web browser John navigates to http://www.aviationweather.gov/wifs/data
2. When prompted he enters his WIFS user ID and password
3. He clicks on the PNG->SIGWX->KWBC folder in the folder listing
4. He locates the file of interest
5. He downloads the file from the browser. For example, in Internet Explorer he right clicks on the file name and chooses Save Target As to download the file to his computer.

Use Case Example 2 – Downloading a single file using the GNU wget tool

Below is a use-case scenario for how a fictitious user (John Smith) identifies a single file he wants and uses wget to download it from WIFS. In this case, John knows he wants a Significant Weather PNG chart.

1. First John must identify the file he wants to download. The only thing he knows is that he wants a PNG file.
2. John issues the following command to download a PNG directory listing from WIFS:

   wget --user=johnsmith --password=wxdude https://www.aviationweather.gov/wifs/data/PNG/SIGWX/KWBC/

3. The "index.html" file for the PNG data folder will be downloaded to the current working folder on John's computer. John can then open this file in his browser or a word processing tool to see the directory listing.
4. Once John identifies the exact file he wants, he downloads the file using wget:

   On the command line from his computer, John types the following command:

wget --user=johnsmith --password=wxdude https://www.aviationweather.gov/wifs/data/PNG/SIGWX/KWBC/20100715_0600_PGEE05_KKCI.png

5. John's file will be downloaded to the current working directory on his computer.

Use Case Example 3 – Downloading multiple files at once

Below is a use-case scenario for how a fictitious user (John Smith) uses Wget to download multiple files at once from WIFS. In this case, John knows he wants all of the PNG charts.

1. First John changes his current working directory to the directory where he wants the files to be stored.
2. On the command line from his computer, John issues the following command:

   wget --user=johnsmith --password=wxdude --recursive --no-directories https://www.aviationweather.gov/wifs/data/PNG/SIGWX/KWBC

All of the files in the PNG directory will be downloaded to the current working directory on John's computer.

Appendix B. GNU wget

GNU wget is a free software package for retrieving files using HTTP, HTTPS and FTP, the most widely-used Internet protocols. It is a non-interactive command-line tool that can be executed from programs, scripts, and cron jobs. GNU wget has many features to make retrieving large files easy, including:

- Can resume aborted downloads, using REST and RANGE
- Can use filename wild cards and recursively mirror directories
- NLS-based message files for many different languages
- Optionally converts absolute links in downloaded documents to relative, so that downloaded documents may link to each other locally
- Runs on most UNIX-like operating systems as well as Microsoft Windows
- Supports HTTP proxies
- Supports HTTP cookies
- Supports persistent HTTP connections
- Unattended / background operation
- Uses local file timestamps to determine whether documents need to be re-downloaded when mirroring
- GNU wget is distributed under the GNU General Public License.

To download GNU wget, navigate to http://ftp.gnu.org/gnu/wget/.

GNU wget documentation can be found at http://www.gnu.org/software/wget/manual/.

The structure of the command including only the required arguments is described below. The wget utility is powerful and includes the capability of performing recursion, statistics, logging, and much more.

wget --user=<user> --password=<password> <URL>

where

user = your WIFS login name
password = your WIFS password

Appendix C. WAFS Upper Air GRIB2 Details

Description	GRIB2 Product Discipline (Section 0, Octet 7)	GRIB2 Product Category (Section 4, Octet 10)	GRIB2 Parameter Number (Section 4, Octet 11)	GRIB2 Level Indicator (Section 4, Octet 23 and 29)	GRIB2 Product Definition Template (Section 4, Octet 8 and 9)	GRIB2 Pressure Levels (hPa)	GRIB2 Flight Levels (approximate)	GRIB2 timesteps required
U-component Wind	0	2	2	100	0	850, 750, 700, 600, 500, 400, 350, 300, 275, 250, 225, 200, 175^, 150, 100	050, 080, 100, 140, 180, 240, 270, 300, 320, 340, 360, 390, 410^, 450, 530	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
V-component Wind	0	2	3	100	0	850, 700, 600, 500, 400, 350, 300, 275, 250, 225, 200, 175^, 150, 100	050, 100, 140, 180, 240, 270, 300, 320, 340, 360, 390, 410^, 450, 530	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Temperature	0	2	2	100	0	850, 750, 700, 600, 500, 400, 350, 300, 275, 250, 225, 200, 175^, 150, 100	050, 080, 100, 140, 180, 240, 270, 300, 320, 340, 360, 390, 410^, 450, 530	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Relative Humidity	0	1	1	100	0	850, 700, 600, 500, 400, 350, 300, 275, 250, 225, 200, 175^, 150, 100	050, 100, 140, 180, 240, 270, 300, 320, 340, 360, 390, 410^, 450, 530	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Tropopause Height (ICAO)	0	3	3	7	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Tropopause Temperature	0	0	0	7	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Maximum U-component Wind	0	2	2	6	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Maximum V-component Wind	0	2	3	6	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Maximum Wind Height (ICAO)	0	3	3	6	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Geopotential Height of Standard levels	0	3	5	100	0	850, 750, 700, 600, 500, 400, 350, 300, 275, 250, 225, 200, 175^, 150, 100	050, 080, 100, 140, 180, 240, 270, 300, 320, 340, 360, 390, 410^, 450, 530	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Mean Icing	0	19	20	100	15	800, 700, 600, 500, 400, 300	060, 100, 140, 180, 240, 300	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Maximum Icing	0	19	20	100	15	800, 700, 600, 500, 400, 300	060, 100, 140, 180, 240, 300	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Mean In-Cloud Turbulence	0	19	20	100	15	700, 600, 500, 400, 300	100, 140, 180, 240, 300	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Max. In-Cloud Turbulence	0	19	20	100	15	700, 600, 500, 400, 300	100, 140, 180, 240, 300	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Mean CAT	0	19	22	100	15	400, 350, 300, 250, 200, 150	240, 270, 300, 340, 390, 450	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
Maximum CAT	0	19	22	100	15	400, 350, 300, 250, 200, 150	240, 270, 300, 340, 390, 450	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
CB Horizontal Extent	0	6	25	10	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
ICAO Height at CB Base	0	3	3	11	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36
ICAO Height at CB Top	0	3	3	12	0	n/a	n/a	6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36

Notable Grid Characteristics:

- Upper Air:
  - Grid will be regular 1.25 x 1.25 degree.
  - Users should refer to the WAFS Change Notice Board for further information.
- Harmonized:
  - Clear Air Turbulence (CAT) for levels 150-400 hPa in 50 hPa increments.
  - In Cloud Turbulence (ICT), combined layer cloud and convective cloud turbulence, for levels 300-700 hPa in 100 hPa increments.
  - Icing for levels 300-800 hPa in 100 hPa increments.
  - Cumulonimbus (CB), horizontal extent, cloud base and cloud tops.

Issuance times:

- 4 issues per day, with DT 00, 06, 12 and 18 UTC.
- 11 time steps at 3 hourly intervals T+6 to T+36.

Data Points:

- 41,760 GRIB 2 global data points with regular 1.25 x 1.25 degree grid.

Bulletins:

- Bulletins range from 20 KB - 70 KB in size containing global field of data.
- 1265 bulletins (858 standard bulletins and 407 harmonized bulletins) per run containing global field of data.

Data volume:

- Data volume is ~40 MB per run before compression (858 bulletins ~30 MB and 407 bulletins ~10 MB).